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Efficacy and Design of Low-Cost Personal Decontamination System (LPDS) Formulations for Sulfur Mustard and Assorted TICs

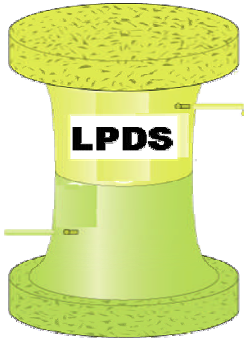
W. J. Smith, A. H. Love, C. J. Koester, J. G. Purdon, P.
O'Dell, J. P. Bearinger, G. A. Keating, A. Noy, M. Verce

December 7, 2005

DECON 2005
Tuscon, AZ, United States
December 12, 2005 through December 15, 2005

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Efficacy and Design of Low-Cost Personal Decontamination System (LPDS) Formulations for Sulfur Mustard and Assorted TICs

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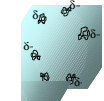
LLNL Civilian Sector CBW Decontamination



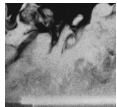
L-Gel & 'Enhanced L-Gel' modified for BWA



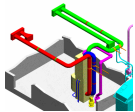
Solid Water Decontaminating Reagent



Particle-Binder Solution



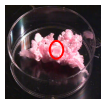
Spore transport & deposition efficiency study



HVAC distribution technique for decon agents



Military & civilian personnel decontamination products



Evaluations of decontamination products with live agents

**Live agent work performed in LLNL's OPCW-Certified
*Forensic Sciences Center***

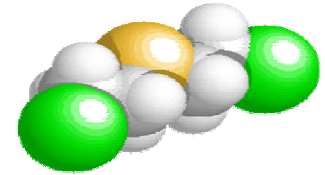


Prototype to Decon On Contact

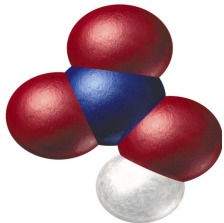


- **Mustard**

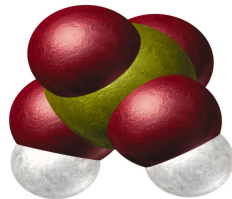
- Difficult to decontaminate on contact
- Existing M291 and RSDL systems require scrubbing



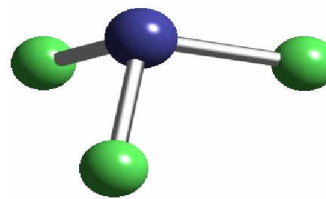
- **Toxic Industrial Chemicals**



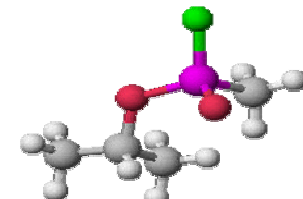
**Nitric
Acid**



**Sulfuric
Acid**

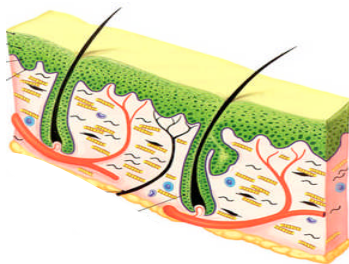


**Phosphorus
Trichloride**



**Pesticide:
Methyl Parathion**

From



Skin



Mucous Membranes



Wounds



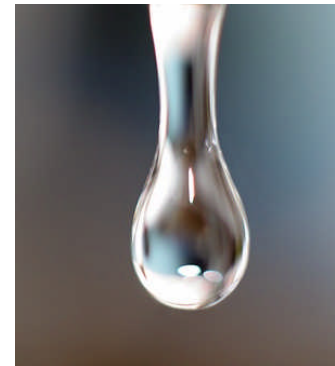
LLNL Team Solution



**1. *Dry Sorbent for
Bulk Chemical
(i.e. Mustard)***



**2. *Reactive Liquid for
Residual***

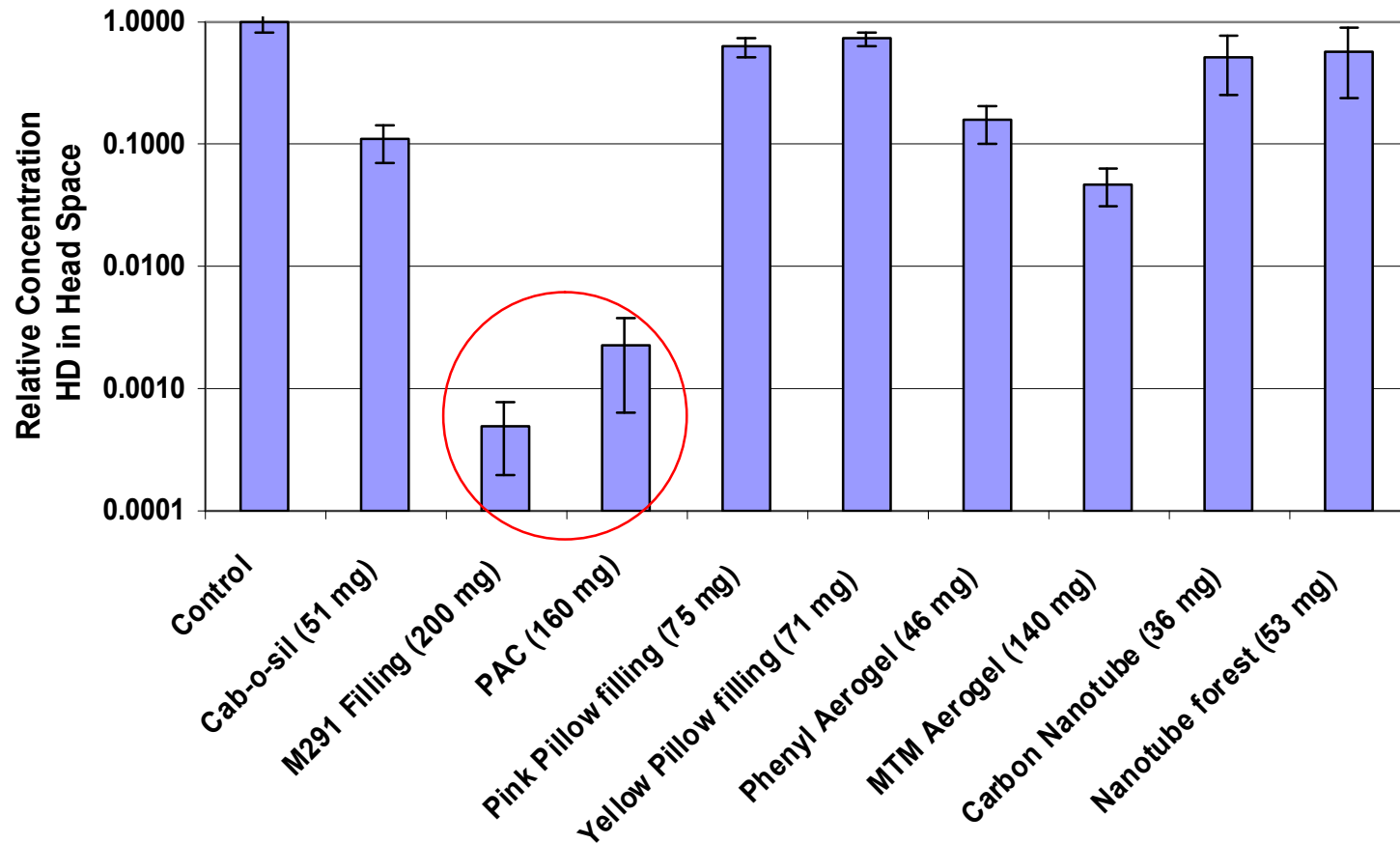




Solid Sorbent Screen with Mustard (HD) Gas



- Retiring DoD M291 Kit Best
- Powdered Activated Carbon Reduces Nearly 1,000 Fold





Solid Sorbent Screen



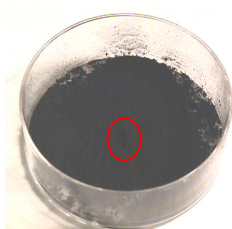
Combination of powdered activated carbon and surfactant-treated polypropylene

- wicks mustard
- controls mustard vapors

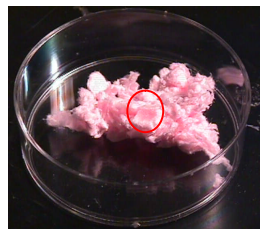
<----- Good Wicking -----> <----- Fair -----> <----- Poor ----->
<-HD Vapor Control ->



M-291



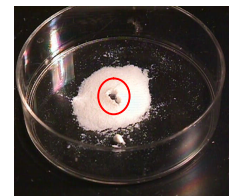
**Powdered
Activated
Carbon**



Polypropylene



Cab-o-sil



Phenyl
Aerogel



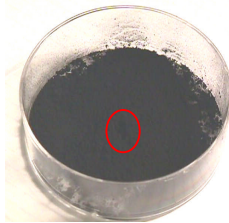
Methyl
Trimethyl
Aerogel



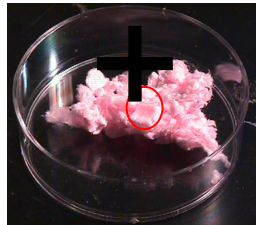
Selected Dry Sorbent



**Powdered
Activated
Charcoal**



Polypropylene



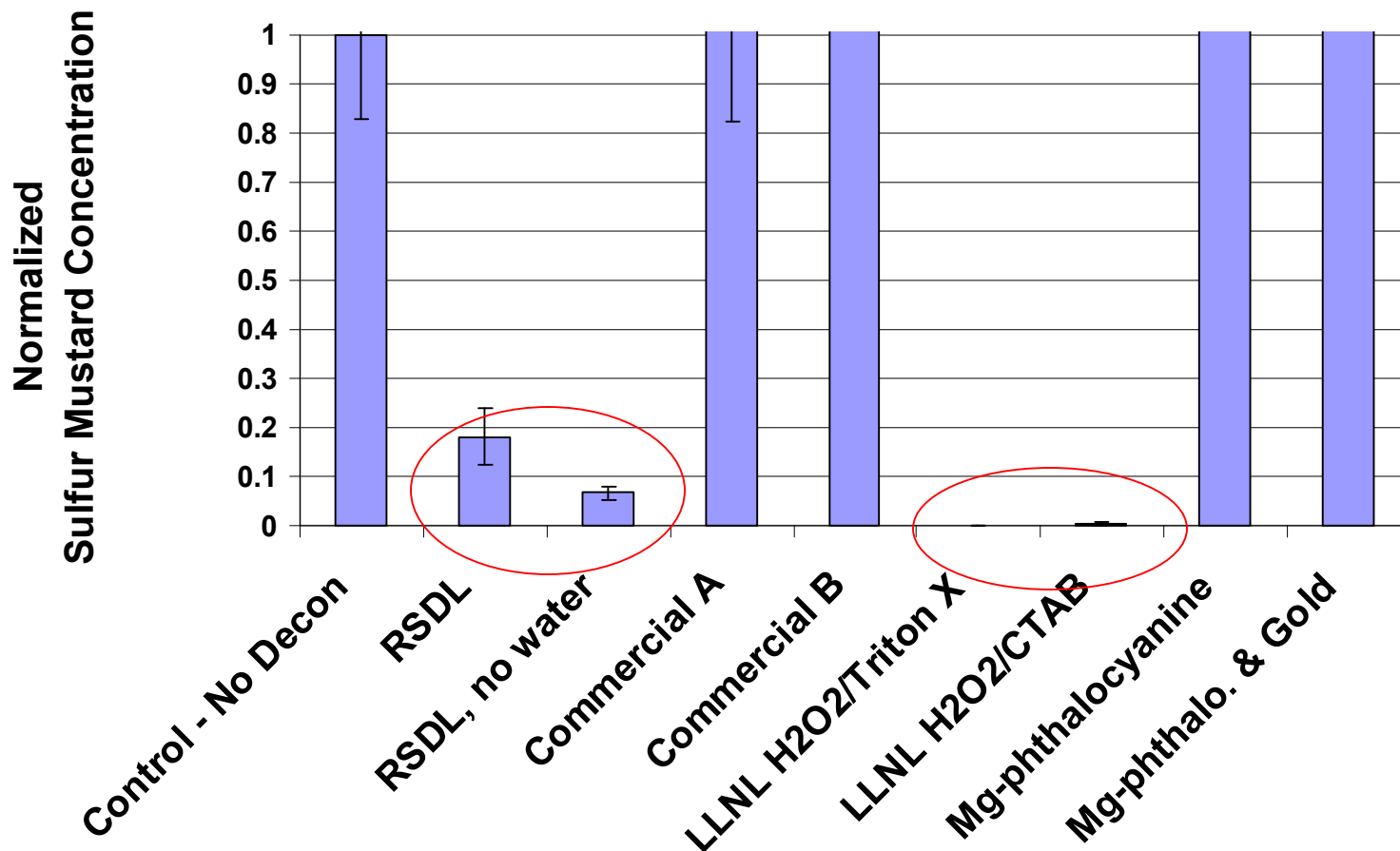
- Contains and absorbs acids, caustics, aqueous fluids and oils
- Surfactant treated polypropylene filler
- Hairy, needle-punched polypropylene skin, fast wicking action
- Widely distributed in spill kits



Liquid Reactivities with Mustard



RSDL[®] & Peroxide Solutions Most Reactive





Selected Reactive Liquid and Applicator



RSDL® Fielded for Years

Reactive Skin Decontamination Lotion

- Developed by Canadian government for nerve agents & mustard gas
- Deployed by NATO and Canada







- Licensed to E-Z-EM
- Approved by FDA for use on skin
- Current Packaging Developed by E-Z-EM/O'Dell/ DRDC Suffield
- LLNL, DRDC Suffield, E-Z-EM, and O'Dell Engineering signed CRADA to improve RSDL®



Neutralization of TICs



- **RSDL® Capacity Adequate for Mineral Acids**
- **Temperature Burns Possible Unless Bulk Removed by Sorption**

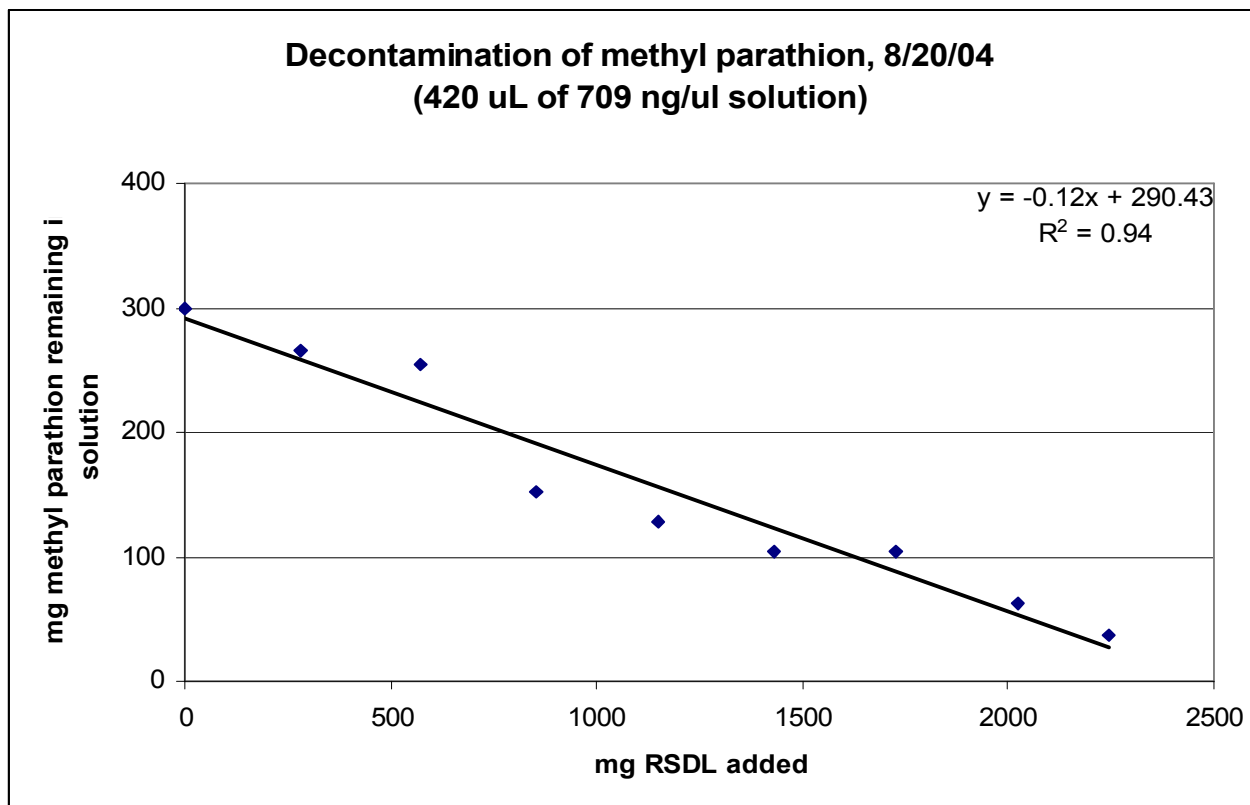
			
RSDL® / Chemical (gm/gm)	20	10	PCl ₃ decomposed by Moisture in Air
Maximum Thickness of Concentrated Acid Layer to Avoid Skin Burn When RSDL® Applied (mm)	0.03	0.05	0.1 mm after PCl ₃ decays



Neutralization of TICs



8 g RSDL[®] degrades 1 g methyl parathion





Prototype LPDS



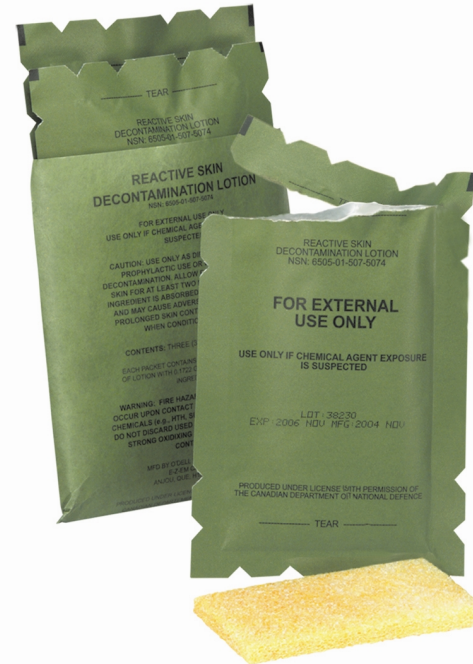
1. Press



Sorbent Sponge



2. Scrub



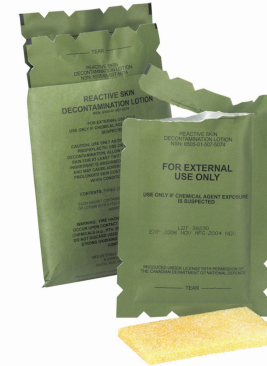
Wet Reactive Sponge



1. Remove bulk material by pressing sorbent sponge.
2. Scrub residual with wet, RSDL lotion-filled reactive sponge.



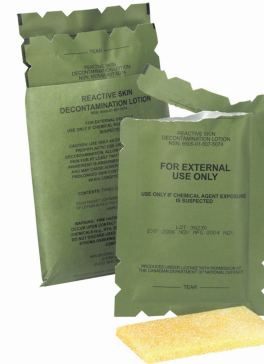
Prototype Components



- Inert polypropylene fibers as general sorbent
- Powdered Act. Carbon
 - Reduces vapors
 - Reacts with strong oxidizers
- Encased in polypropylene fabric resistant to acids, bases, oxidizers and reducers
- Proprietary sponge filled with RSDL®
- Air-tight tear-open packet critical to shelf-life



Prototype Features



- Efficacious for broad range of CBW agents and TICs
- Compatible with all but strongest oxidizers
- Low residual concentration of CBW agent or TIC
- Components demonstrated for
 - Mustard
 - Acid TICs
 - OP pesticide malathion
 - GB, GD and VX
- Design capacity > existing M291 kit
- Expected shelf-life at least 3 years
- No water required



Prototypes Soon



- Status
 - Decon more skin than current military kits
 - 50 prototypes to DHS/TSWG in FY06
 - Manufacturing transition plan in preparation





Prototype Features

Wounds & Mucous Membranes



Mucous Membranes

- Sponge & RSDL® for oral cavity
- RSDL® for eye and nasal cavity

Wounds

- Sponge wicks fluids, chemical agents & TICs out of wound
- RSDL® may then permeate more quickly & deeply to react with agents & TICs in tissues
- No agreement on clinical model

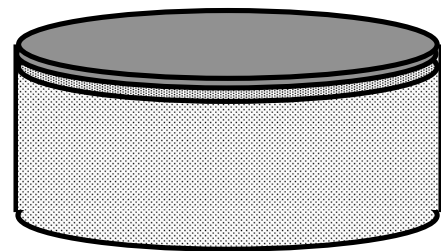
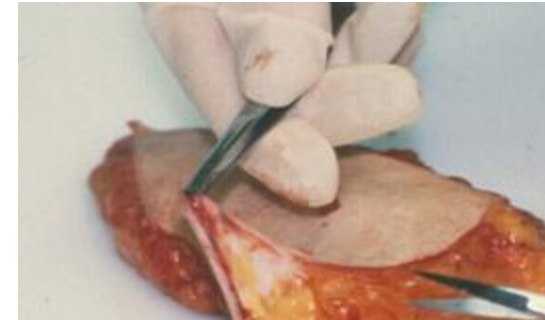
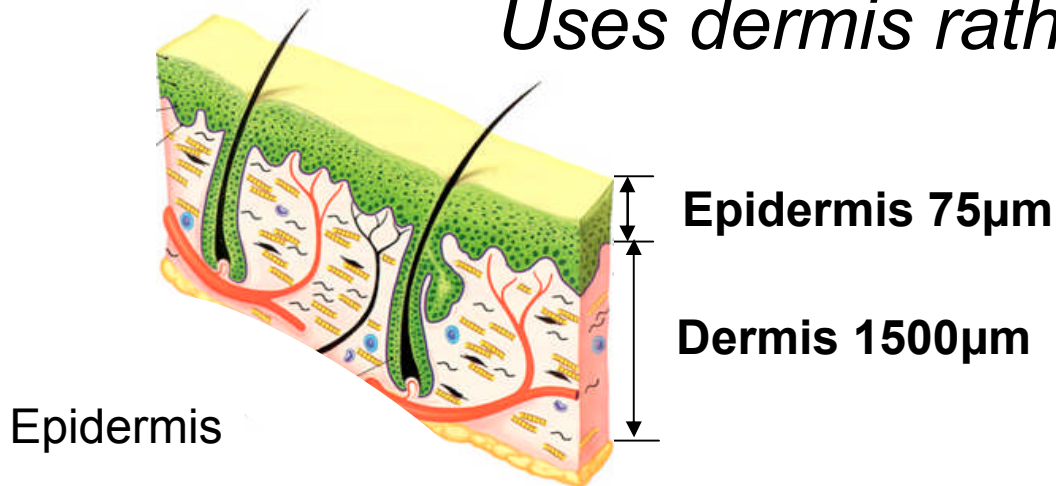
RSDL® use on skin has been approved by FDA.
Oral use and use for eye, nose and wounds has not.



Membrane & Wound Model



Uses dermis rather than epidermis



Base
Vapor
Separation

